NT5D33 and NTRB34 Line-side E1 Interface Cards

Contents

This section contains information on the following topics:

Introduction 126

Physical description 126

Card connections 127

Faceplate 127

Functional description 131

Overview 131

Card interfaces 133

Electrical specifications 135

E1 channel specifications 136

Power requirements 136

Foreign and surge voltage protections 136

Installation and Configuration 137

Dip switch settings 138

Installation 144

Cabling the line-side E1 card (LEI) 146

Terminal configuration 152

Man-Machine E1 maintenance interface software 155

Description 155

Basic commands 159

Configuring parameters 161

Performance counters and reporting 176

Reference list

The following reference is in this section:

- *Administration* (553-3001-311)

Introduction

The Line-side E1 Interface card (LEI) is an Intelligent Peripheral Equipment (IPE) line card. The LEI card provides an all-digital connection between E1-compatible terminal equipment, such as a voice mail system, and a Meridian 1.

The LEI interfaces one E1 line, carrying 30 channels, to the Meridian 1. The LEI emulates an analog line card to the Meridian 1 software. Each channel is independently configured by software control in the Analog (500/2500-type) Telephone Administration program LD 10. The LEI also comes equipped with a Man-Machine Interface (MMI) maintenance program, which provides diagnostic information regarding the status of the E1 link.

Install the NT5D33 version of the LEI in the NT8D37 IPE module.

Install the NT5D34 version of the LEI in:

- the NTAK11 Option 11C Main Cabinet
- the Option 11C NTAK12 Expansion Cabinet
- the NT1P70 Small Remote IPE Main Cabinet
- the NTAK12 Small Remote IPE Expansion Cabinet

Physical description

The LEI mounts in two consecutive card slots in the IPE shelf. It uses 16 channels on the first slot and 14 channels on the second. The LEI includes a motherboard (31.75 by 25.40 cm. (12.5 by 10 in.) and a daughterboard (5.08 by 15.24 cm. (2 by 6 in.)

Card connections

The LEI uses the NT8D81AA Tip and Ring cable to connect from the IPE backplane to the 25-pair Amphenol connector on the IPE Input/Output (I/O) panel. The I/O panel connector connects to a E1 line, external alarm and an MMI terminal or modem, using the NT5D35 or NT5D36 Line-side I/O cable available from Nortel Networks.

Faceplate

The LEI faceplate is twice as wide as the other standard analog and digital line cards. It occupies two card slots. The LE1 faceplate has four LEDs. See Figure 26 on page 128 (IPE version), and Figure 27 on page 129 (Option 11C and small remote cabinet version.)

The LEDs give status indications on the operations as described in Table 29:

Table 29
Line-side E1 card LED operation

LED	Operation
Status	Line card
Red alarm	E1 near end
Yellow alarm	E1 far end
Maint	Maintenance

Figure 26
NT5D33AB Line-side E1 card – faceplate

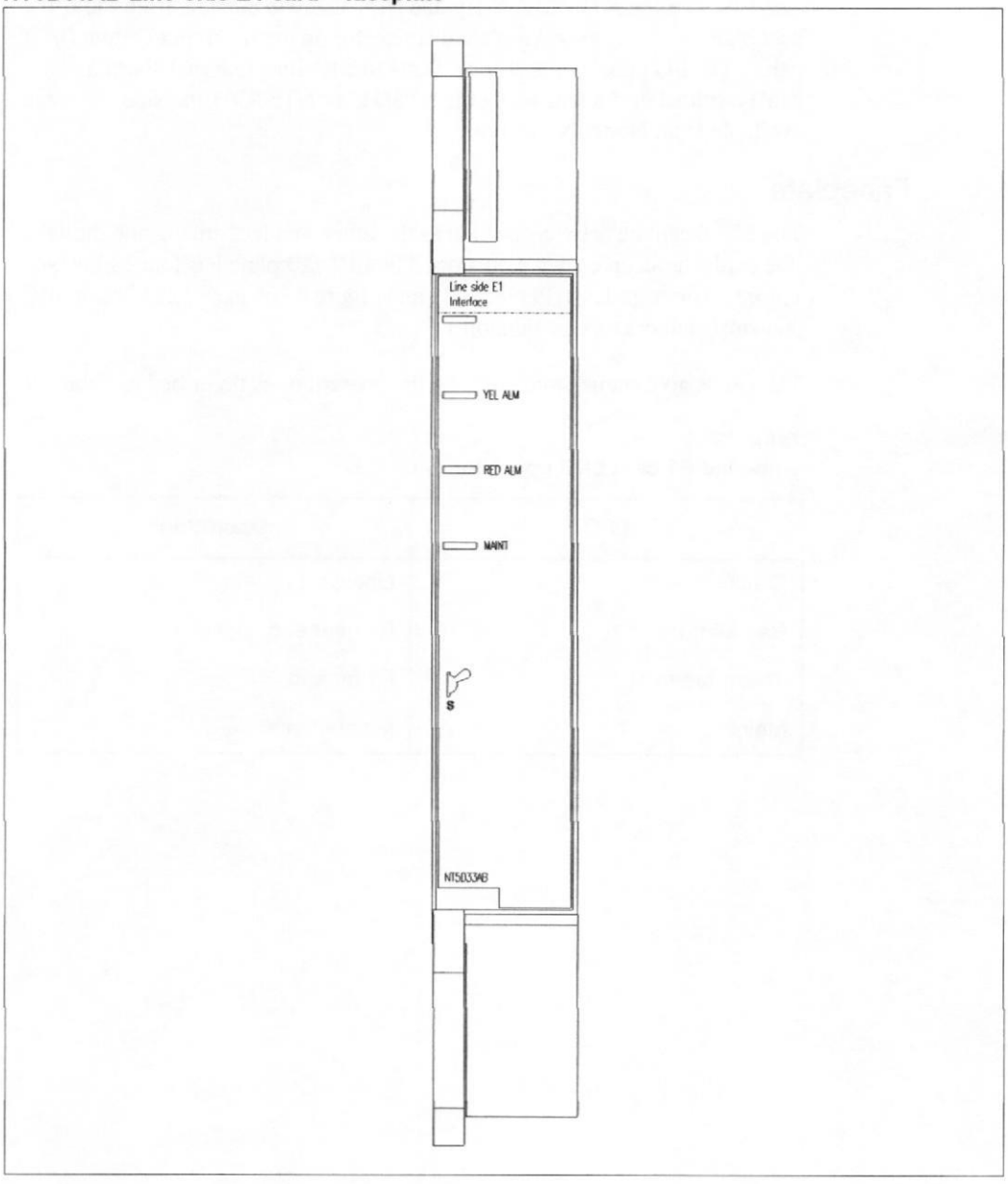
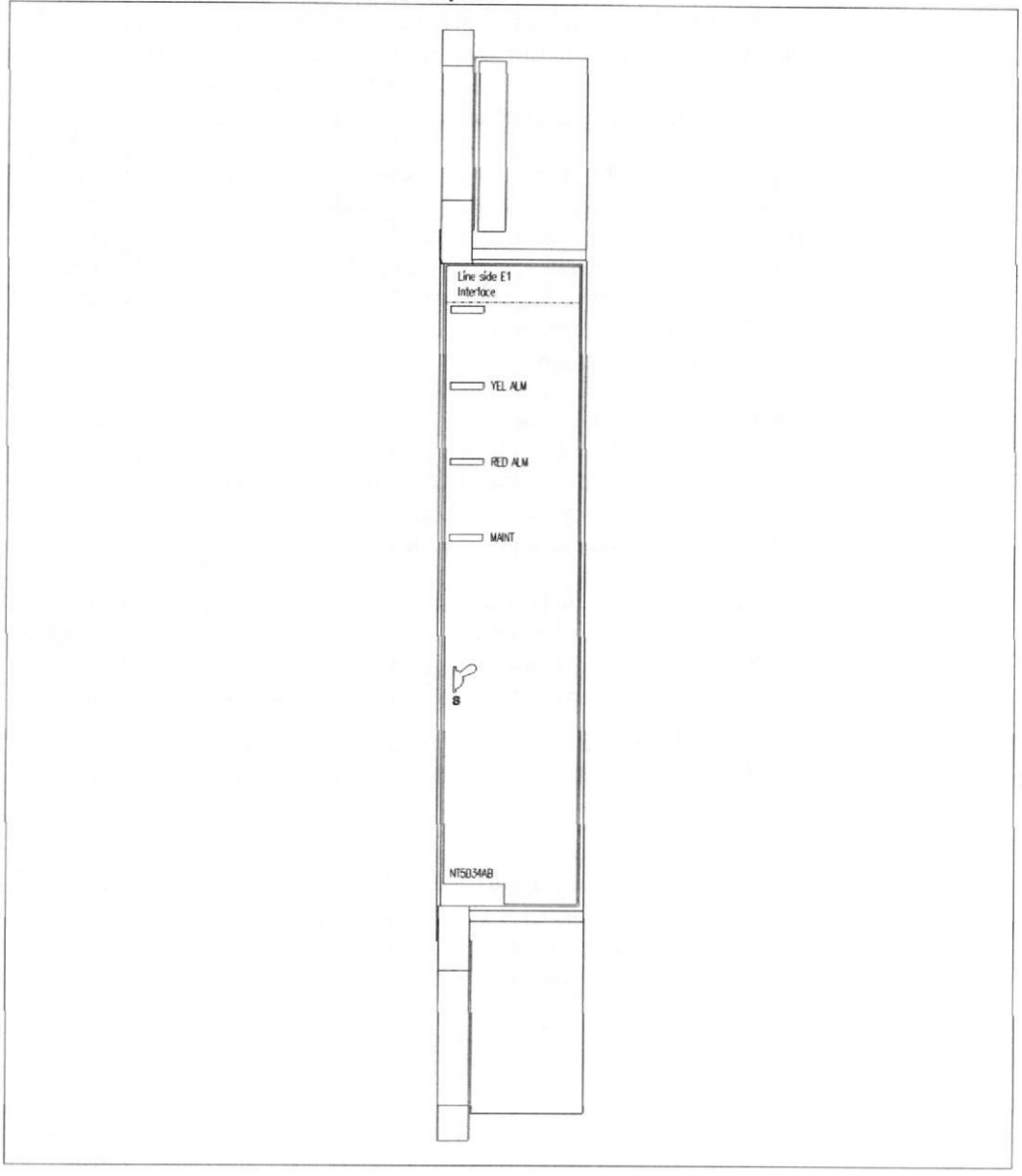


Figure 27
NT5D34AB Line-side E1 line card – faceplate



The **STATUS** LED indicates if the LEI has successfully passed its self test, and therefore, if it is functional. When the card is installed, this LED remains lit for two to five seconds as the self-test runs. If the self-test completes successfully, the LED flashes three times and remains lit. When the card is configured and enabled in software, the LED goes out. If the LED continually flashes or remains weakly lit, replace the card.

The STATUS LED indicates the enabled/disabled status of both card slots of the LEI simultaneously. To properly enable the card, both the motherboard and the daughterboard slots must be enabled. The STATUS LED will turn off as soon as either one of the LEI slots have been enabled. No LED operation will be observed when the second card slot is enabled. To properly disable the card, both card slots must be disabled. The LED will not turn on until both card slots have been disabled.

The **RED ALARM LED** indicates if the LEI has detected an alarm condition from the E1 link. Alarm conditions can include such conditions as not receiving a signal, the signal has exceeded bit error thresholds or frame slip thresholds. See "Man-Machine E1 maintenance interface software" on page 155 for information on E1 link maintenance.

If one of these alarm conditions is detected, this LED will light. Yellow alarm indication is sent to the far end as long as the near end remains in a red alarm condition. Depending on how the Man Machine Interface (MMI) is configured, this LED will remain lit until one the following actions occur:

- If the "Self-Clearing" function is enabled in the MMI, the LED will clear the alarm when the alarm condition is no longer detected. This is the factory default configuration.
- If the "Self-Clearing" function has not been enabled or it has been subsequently disabled in the MMI, the LED alarm indication will stay lit until the command "Clear Alarm" has been typed in the MMI, even though the carrier automatically returned to service when the alarm condition was no longer detected.

The **YELLOW ALARM** LED indicates that the LEI has detected a yellow alarm signal from the terminal equipment side of the E1 link. See "Man-Machine E1 maintenance interface software" on page 155 for information on E1 link maintenance. If the terminal equipment detects a red alarm condition such as not receiving a signal, or the signal exceeds bit-error thresholds or frame-slip thresholds, a yellow alarm signal is sent to the LEI, if the terminal equipment supports this feature. If a yellow alarm signal is detected, this LED will light.

The **MAINT** LED indicates if LEI is fully operational because of certain maintenance commands that are issued through the MMI. See "Man-Machine E1 maintenance interface software" on page 155 for information on E1 link maintenance. If the card detects that tests are being run or that alarms have been disabled through the MMI, this LED will light and will remain lit until these conditions are no longer detected, then it turns off.

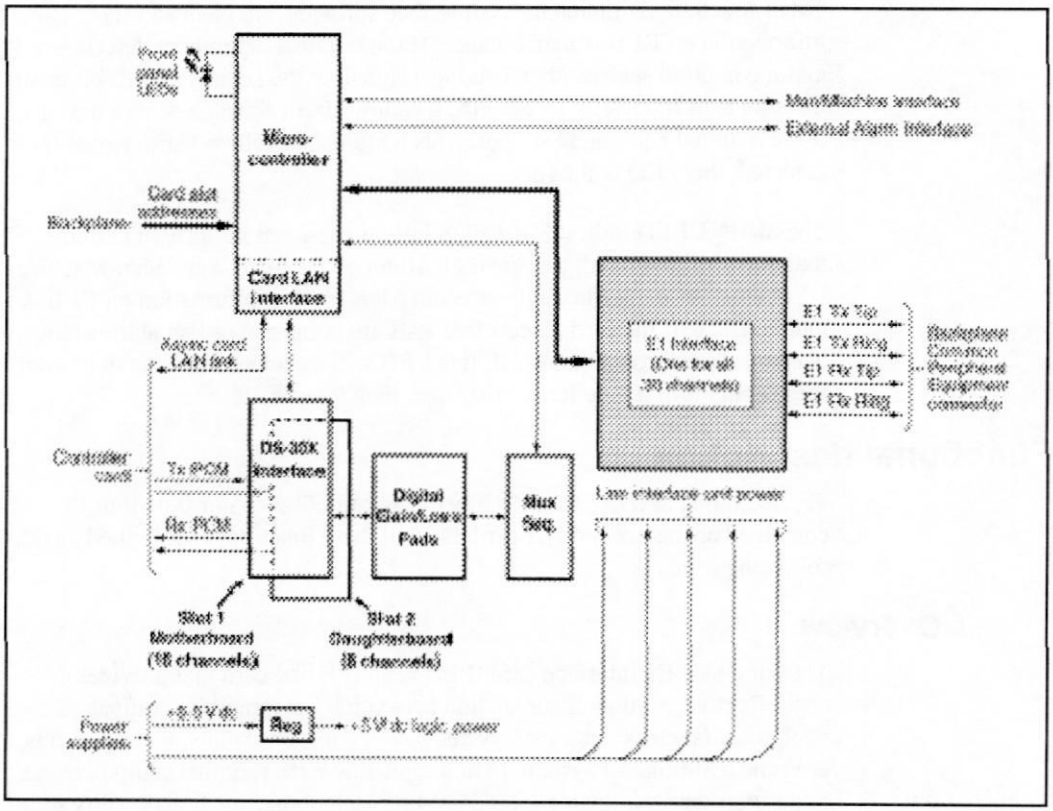
Functional description

Figure 28 on page 132 shows a block diagram of the major functions contained on the line-side E1 card. Each of these functions is described on the following pages.

Overview

The Line-side E1 Interface card (LEI) is an IPE line card that provides a cost-effective, all-digital connection between E1-compatible terminal equipment (such as voice mail systems, voice response units, trading turrets, etc.) and a Meridian 1 system. In this application, the terminal equipment can be assured access to analog (500/2500-type) telephone line functionality such as hook flash, SPRE codes and ringback tones generated from the Meridian 1. The LEI supports line supervision features such as loop and ground start protocols. It can also be used in an off-premise arrangement where analog (500/2500-type) telephones are extended over twisted-pair or coaxial E1 with the use of channel bank equipment.

Figure 28
Line-side E1 card – block diagram



The LEI offers significant improvement over the previous alternatives. For example, if a digital "trunk-side" connection were used, such as with the DTI/PRI interface card, "line-side" functionality would not be supported. Previously, the only way to achieve line-side functionality was to use analog ports and channel bank equipment. With the LEI, a direct connection is provided between the Meridian 1 and the peripheral equipment. No channel bank equipment is required, resulting in a more robust and reliable connection.

When used for connecting to third-party applications equipment, the LEI offers a number of benefits. It is a more cost-effective alternative for connection because it eliminates the need for expensive channel bank equipment. The Line-side E1 supports powerful E1 monitoring, and diagnostic capability. Overall costs for customer applications may also be reduced because the E1-compatible peripheral equipment is often more attractively priced than the analog-port alternatives.

The LEI is compatible with all IPE-based systems and with standard public or private CEPT-type carrier facilities. It supports CRC-4- or FAS-only framing formats as well as AMI or HDB3 coding. Because it uses standard PCM in standard E1 timeslots, existing E1 test equipment remains compatible for diagnostic and fault isolation purposes. A/B Bit signaling may be customized according to the user's system, including the Australian P2 signaling scheme.

Card interfaces

The LEI passes voice and signaling data over DS-30X loops through the DS-30X Interface circuits and maintenance data over the card LAN link.

E1 interface circuit

The LEI contains one E1 line-interface circuit which provides 30 individually configurable voice interfaces to one E1 link in 30 different time slots. The circuit demultiplexes the 2.56 Mbps DS-30X transmit signaling bitstreams from the DS-30X network loop and converts it into 2.048 mHz E1 transmit signaling bitstreams onto the E1 link. It also does the opposite, receiving receive signaling bitstreams from the E1 link and transmitting receive signaling bitstreams onto the DS-30X network loop.

The E1 interface circuit provides the following:

- An industry standard CEPT (0 to 655 feet) interface
- DS-30X signaling protocol into FXO A- and B-channel-associated signaling protocol
- Switch-selectable transmission and reception of E1 signaling messages over an E1 link in either loop or ground start mode
- Switch-selectable call processing between the Australian P2, North American Standard, or other user-configurable schemes

Signaling and control

The LEI also contains signaling and control circuits that establish, supervise, and take down call connections. These circuits work with the system controller to operate the E1 line interface circuit during calls. The circuits receive outgoing call signaling messages from the controller and return incoming call status information to the controller over the DS-30X network loop.

Card control functions

Control functions are provided by a microcontroller and a card LAN link on the LEI. A sanity timer is provided to automatically reset the card if the microcontroller stops functioning for any reason.

Microcontrollers

The LEI contains a microcontroller that controls the internal operation of the card and the serial card LAN link to the controller card. The microcontroller controls the following:

- reporting to the CE CP through the card LAN link
  - card identification (card type, vintage, serial number)
  - firmware version
  - self-test results
  - programmed unit parameter status
- receipt and implementation of card configuration
  - control of the E1 line interface
  - enabling/disabling of individual units or entire card
  - programming of loop interface control circuits for administration of channel operation
  - maintenance diagnostics

- interface with the line card circuit
  - converts on/off-hook, and ringer control messages from the DS-30X loop into A/B bit manipulations for each time slot in the E1 data stream, using channel associated signaling.

- the front panel LED when the card is enabled or disabled by instructions from the NT8D01 controller card.

Card LAN interface

Maintenance data is exchanged with the Common Equipment CPU over a dedicated asynchronous serial network called the Card LAN link. The Card LAN link is described in "Card LAN link" on page 22.

Sanity Timer

The LEI also contains a sanity timer that resets the microcontroller in the event of a loss of program control. If the timer is not properly serviced by the microcontroller, it times out and causes the microcontroller to be hardware-reset. If the microcontroller loses control and fails to service the sanity timer at least once per second, the sanity timer will automatically reset the microcontroller, restoring program control.

Man-Machine Interface

The LEI provides an optional Man-Machine Interface (MMI) that is primarily used for E1 link performance monitoring and problem diagnosis. The MMI provides alarm notification, E1 link performance reporting, and fault isolation testing. The interface is accessed through connections from the I/O panel to a terminal or modem. Multiple cards (up to 64) can be served through one MMI terminal or modem by linking the LEIs through a daisy chain.

The MMI is an optional feature, since all E1 configuration settings are performed through dip switch settings or preconfigured factory default settings. Available MMI commands, and their functionality, are discussed in-depth in "Man-Machine E1 maintenance interface software" on page 155.

Electrical specifications

Table 30 on page 136 provides a technical summary of the E1 line interface. Table 31 on page 136 lists the maximum power consumed by the card.

E1 channel specifications

Table 30 provides specifications for the 30 E1 channels. Each characteristic is set by a dip switch. See "Installation and Configuration" on page 137. for a discussion of the corresponding dip switch settings.

Table 30
Line-side E1 card — line interface unit electrical characteristics

Characteristics	Description
Framing	CRC-4 or FAS, only
Coding	AMI or HDB3
Signaling	Loop or ground start A/B robbed-bit
Distance to LTU	0-199.6 meters (0-655 feet)

Power requirements

Table 31 shows the voltage and maximum current that the LEI requires from the backplane. One NT8D06 Peripheral Equipment Power Supply ac or NT6D40 Peripheral Equipment Power Supply dc can supply power to a maximum of eight LEIs.

Table 31
Line-side E1 card – power required

Voltage	Max. Current
5.0 V dc	1.6 Amp
+15.0 V dc	150 mA
-15.0 V dc	150 mA

Foreign and surge voltage protections

In-circuit protection against power line crosses or lightning strikes is not provided on the LEI. It does, however, have protection against accidental shorts to –52 V dc analog lines.

When the card is used to service off-premise terminal equipment through the public telephone network, install a Line Termination Unit (LTU) as part of the terminal equipment to provide external line protection.

Environmental specifications

Table 32 shows the environmental specifications of the LEI.

Table 32
Line-side E1 card – environmental specifications

Parameter	Specifications
Operating temperature – normal	15° to +30° C (+59° to 86° F), ambient
Operating temperature – short term	10° to +45° C (+50 to 113° F), ambient
Operating humidity – normal	20% to 55% RH (non-condensing)
Operating humidity – short term	20% to 80% RH (non condensing)
Storage temperature	–50° to + 70° C (–58° to 158° F), ambient
Storage humidity	5% to 95% RH (non-condensing)

Installation and Configuration

Installation and configuration of the LEI consists of six basic steps:

1 Set the dip switches on the LEI for the call environment.

2 Install the LEI into the selected card slots.

3 Cable from the I/O panel to the LTU, MMI terminal or modem (optional), external alarm (optional), and other LEIs for daisy chaining use of MMI terminal (optional).

4 Configure the MMI terminal.

5 Configure the LEI through the Meridian 1 software and verify self-test results.

6 Verify initial E1 operation and configure MMI (optional).

Steps 1-5 are explained in this section. Step 6 is covered in "Man-Machine E1 maintenance interface software" on page 155.

Dip switch settings

Begin the installation and configuration of the LEI by selecting the proper dip switch settings for the environment. The LEI contains two dip switches, each containing eight switch positions. They are located in the upper right corner of the motherboard circuit card as shown in Figure 29 on page 139. The settings for these switches are shown in Tables 33 through 36.

When the line-side E1 card is oriented as shown in Figure 29, the dip switches are ON when they are up, and OFF when they are down. The dip switch settings configure the card for the following parameters:

MMI port speed selection

This dip switch setting selects the appropriate baud rate for the terminal or modem (if any) that is connected to the MMI.

Line Supervisory Signaling protocol

The LEI is capable of supporting loop start or ground start call processing modes. Make the selection for this dip switch position based on what type of line signaling the Customer Premise Equipment (CPE) supports.

Address of LEI to the MMI

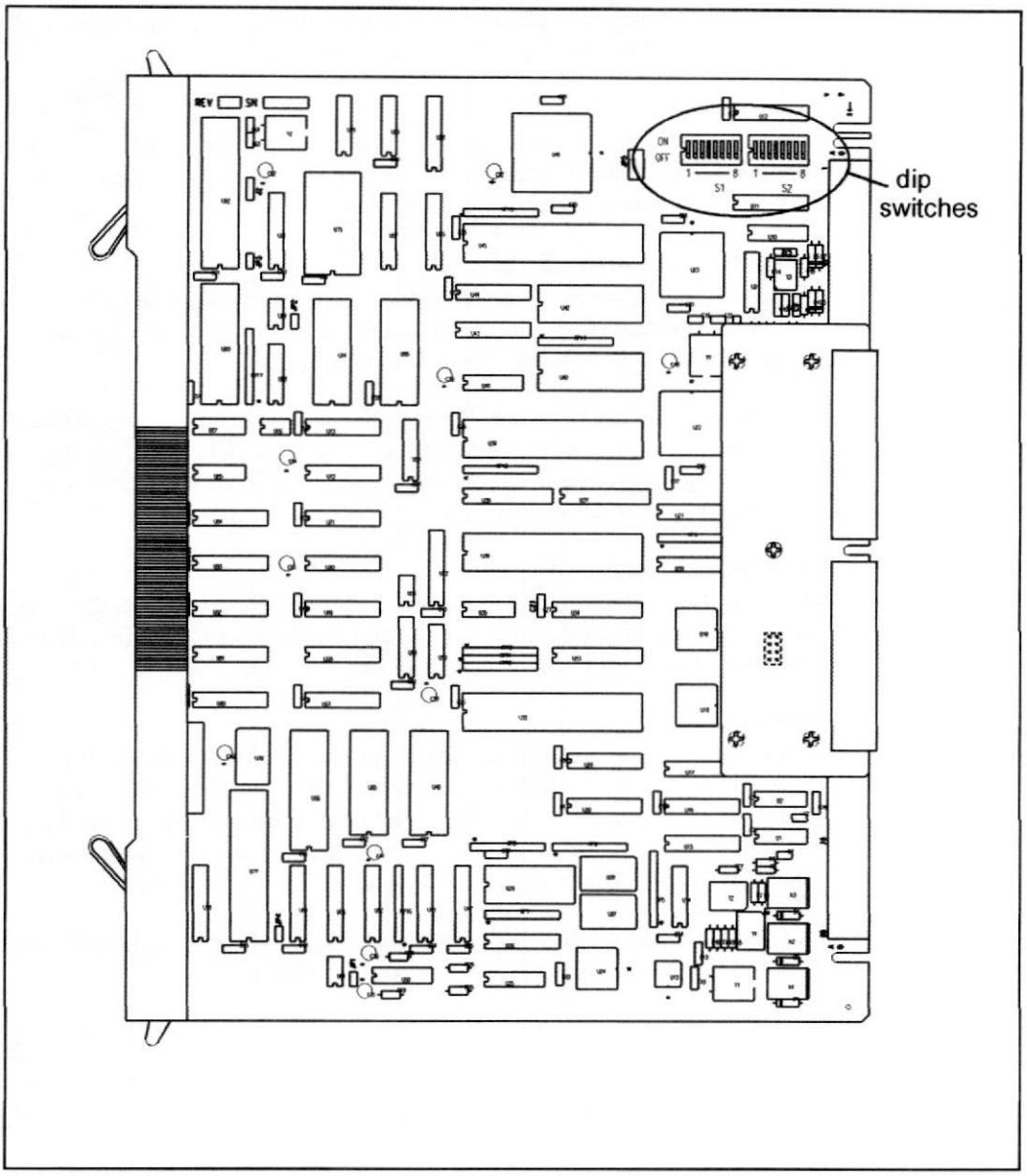
The address of the LEI to the MMI is made up of two components:

- the address of the card within the shelf
- the address of the shelf in which the card resides.

These two addresses are combined to create a unique address for the card. The MMI reads the address of the card within the shelf from the card firmware; the address of the shelf must be set by this dip switch.

The shelf address dip switch can be from 0 – 15, 16 being the maximum number of Line-side E1 IPE shelves (a maximum of 64 LEI cards) capable of daisy chaining to a single MMI terminal. For ease, it is recommended that this address be set the same as the address of the peripheral controller identifier in LD 97 for type: XPE. However, this is not mandatory, and, since the dip switch is limited to 16, this will not always be possible.

Figure 29
Line-side E1 card – E1 protocol dip switch locations



E1 framing

The LEI is capable of interfacing with LTU equipment either in CRC-4 or FAS only framing mode. Make the selection for this dip switch position based on what type of framing the LTU equipment supports.

E1 Coding

The LEI is capable of interfacing with LTU equipment using either AMI or HDB3 coding. Make the selection for this dip switch position based on the type of coding the LTU equipment supports.

Line supervision on E1 failure

This setting determines in what state all 30 LEI ports will appear to the Meridian 1 in case of E1 failure. Ports can appear to the Meridian 1 as either in the "on-hook" or "off-hook" states on E1 failure.

> ***Note:*** All idle LEI lines will go off-hook and seize a Digitone Receiver when the off-hook line processing is invoked on E1 failure. This may prevent DID trunks from receiving incoming calls until the LEI lines time-out and release the DTRs.

Daisy-Chaining to MMI

If two or more LEIs will be installed and the MMI used, daisy-chain the cards together to use one MMI terminal or modem. Make the selection for this dip switch position based on how many LEIs are being installed.

MMI Master or Slave

This setting is used only if daisy-chaining the cards to the MMI terminal or modem. It determines whether this card is a master or a slave in the daisy chain. Select the master setting if there are no LEIs between this card and the MMI terminal or modem. Select the slave setting if there are other cards in the daisy chain between this card and the MMI.

Tables 33 through 35 show the dip switch settings for Switch #1. Table 36 on page 143 shows the dip switch settings for Switch #2.

Table 33
Line-side E1 card – Switch #1 dip switch settings

Characteristic	Selection	Switch Position	Switch Setting	Factory Default
MMI port speed selection	1200 baud	1	ON	OFF
	2400 baud	1	OFF	
E1 signaling	Ground start	2	ON	OFF
	Loop start	2	OFF	
IPE Shelf address for LEI	See Table 35	3	See Table 35	OFF
		4		OFF
		5		OFF
		6		OFF
Card type for ringer allocation	XTI = 19	7	ON	OFF
	XMLC = 18	7	OFF	
E1 signaling	See Table 34	8	OFF	OFF

When dip switch #1, positions 2 and 8 are set to "Table," AB Bits are configured by the user through the Set Mode MMI command (see "Set Mode" on page 167). Otherwise, the signaling scheme selected by dip switch 1, positions 2 and 8 will be used.

Table 34
Line-side E1 card – signaling-type dip switch settings

Switch #1			
Characteristic	**Selection**	**Position 2**	**Position 8**
Signaling Type	Loop start	OFF	OFF
	Ground start	ON	OFF
	Australian P2	OFF	ON
	Table	ON	ON

Table 35
Line-side E1 card – XPEC address dip switch settings (Switch S1, positions 3-6)

XPEC Address	S1 Switch Position 3	S1 Switch Position 4	S1 Switch Position 5	S1 Switch Position 6
00	OFF	OFF	OFF	OFF
01	ON	OFF	OFF	OFF
02	OFF	ON	OFF	OFF
03	ON	ON	OFF	OFF
04	OFF	OFF	ON	OFF
05	ON	OFF	ON	OFF
06	OFF	ON	ON	OFF
07	ON	ON	ON	OFF
08	OFF	OFF	OFF	ON
09	ON	OFF	OFF	ON
10	OFF	ON	OFF	ON
11	ON	ON	OFF	ON
12	OFF	OFF	ON	ON
13	ON	OFF	ON	ON
14	OFF	ON	ON	ON
15	ON	ON	ON	ON

Table 36
Line-side E1 card – E1 Switch 2 (S2) dip switch settings

Characteristic	Selection	Switch Position	Switch Setting	Factory Default
E1 framing	CRC-4 Disabled	1	ON	OFF
	CRC-4 Enabled	1	OFF	
E1 coding	AMI	2	ON	OFF
	HDB3	2	OFF	
NOT USED	leave ON	3	ON	ON
	leave OFF	4	OFF	OFF
	leave OFF	5	OFF	OFF
Line processing on E1 link failure	On-hook	6	ON	ON
	Off-hook	6	OFF	
Daisy-chaining to MMI	YES	7	ON	OFF
	NO	7	OFF	
MMI master or slave	Master	8	ON	ON
	Slave	8	OFF	

After the card has been installed, display the dip switch settings using the MMI command **Display Configuration (D C)**. See "Man-Machine E1 maintenance interface software" on page 155 for details on this and the rest of the available MMI commands.

Installation

Because of the wiring in some of the Meridian 1 modules and cabinets, the LEI will only work in certain card slot pairs. These restrictions depend on the type of module or cabinet. In all other modules or cabinets where the conditions listed below do not exist, the LEI will work in any two adjacent card slots.

- In the NTAK12 Small Remote IPE Expansion Cabinet only card slots 10-15 are available
- In the NT8D37 IPE Module, if the 25-pair I/O connectors are partially split between adjacent IPE card slots, the LEI works only in card slots where Unit 0 of the motherboard card slot appear on the first pair of the 25-pair I/O connector.

If installing the LEI into the NT8D37 IPE module, determine the vintage level model. Certain vintage levels have dedicated 25-pair I/O connectors only for card slots 0, 4, 8, and 12. These vintage levels are cabled with only 16 pairs of wires from each card slot to the I/O panel. Some of the 25-pair I/O connectors are split between adjacent card slots.

Other vintage levels cable each card slot to the I/O panel using a unique, 24-pair connector on the I/O panel. In these vintage levels, the LEI can be installed in any available pair of card slots. However, because of the lower number of wire pairs cabled to the I/O panel in the lower vintage level, only certain card slots are available to the LEI.

See Table 37 for the vintage level information for the NT8D37 IPE modules

Table 37
Line-side E1 card – NT8D37 IPE Module vintage level port cabling

Vintage Level	Number of ports cabled to I/O panel
NT8D37BA	30 ports
NT8D37DE	16 ports
NT8D37EC	30 ports

Available and restricted card slots in the NT8D37 IPE Module

If installing the LEI into an NT8D37 IPE Module, the card slots available depend on the vintage level module.

Vintage levels cabling 30 ports:

For modules with vintage levels that cabled 30 ports to the I/O panel, the LEI can be installed in any pair of card slots 0-15.

Vintage levels cabling 16 ports:

For modules with vintage levels that cable 16 ports to the I/O panel, the LEI can be installed into the card slot pairs shown in the following card slots:

Available:	Motherboard/Daughterboard
	0 and 1
	1 and 2
	4 and 5
	5 and 6
	8 and 9
	9 and 10
	12 and 13
	13 and 14

LEIs must **not** be installed into the following card slot pairs:

Restricted:	Motherboard/Daughterboard
	2 and 3
	3 and 4
	6 and 7
	10 and 11
	11 and 12
	14 and 15

If the LEI must be installed into one of the restricted card slot pairs, rewire the IPE module card slot to the I/O panel by installing an additional NT8D81 cable from the LEI motherboard slot to the I/O panel, and re-arranging the three backplane connectors for the affected card slots. This will permit the connection of the NT5D35AA or NT5D36AA Line-side E1 card carrier and maintenance external I/O cable at the IPE and CE/PE module I/O panel connector for card slots that are otherwise restricted.

Alternatively, all LEI connections can be made at the main distribution frame instead of connecting the NT5D35AA or NT5D36AA Line-side E1 card external I/O cable at the I/O panel. This eliminates these card slot restrictions.

Cabling the line-side E1 card (LEI)

After the dip switches are set and the LEI installed into the selected card slots, the LEI can be cabled to the LTU equipment, the MMI terminal or modem (optional), an external alarm (optional), and other LEIs for daisy chaining use of the MMI terminal (optional).

The LEI is cabled from its backplane connector through connections from the motherboard circuit card only to the I/O panel on the rear of the IPE module. No cable connections are made from the daughterboard circuit card. The connections from the LEI to the I/O panel are made with the NT8D81AA Tip and Ring cables provided with the IPE module.

Cabling from the I/O panel with the NT5D35AA or NT5D36AA Line-Side E1 I/O cable

In a twisted-pair E1 installation, make the connection from the I/O panel to the E1 link and other external devices with the NT5D35AA Line-side E1 I/O cable.

This cable consists of a 25-pair amphenol connector (P1) on one end which plugs into the I/O panel. The other end has four connectors:

1. a DB15 male connector (P2), which plugs into the E1 line
2. a DB9 male connector (P3), which plugs into an external alarm system
3. a second DB9 male connector (P5), which connects to an MMI terminal or modem
4. a DB9 female connector (P4), which connects to the next LEI's P4 connector for MMI daisy chaining

In a coaxial E1 installation, make the connection from the I/O panel to the E1 link and other external devices through the NT5D36AA Line-side E1 I/O cable.

This cable consists of a 25-pair amphenol connector (P1) on one end which plugs into the I/O panel. The other end has 4 connectors:

1 a DB15 female connector (P2) with an adapter that breaks out Tx (transmit) and Rx (receive) connectors, which that plug into the E1 line

2 a DB9 male connector (P3), which plugs into an external alarm system

3 a second DB9 male connector (P5), which connects to an MMI terminal or modem

4 a DB9 female connector (P4), which connects to the next LEI's P4 connector for MMI daisy chaining. The Tx marking on the adapter at P2 is the LEI output. The E1 data stream coming from the network into the LEI connects at the Rx coaxial connector

Table 38 shows the pin assignments of the LEI backplane and I/O Panel.

Table 38
Line-side E1 card – LEI backplane and I/O panel pinouts (Part 1 of 2)

Backplane connector pin	I/O Panel connector pin	Signal
12A	1	E1 Tip, Receive data
12B	26	E1 Ring, Receive data
13A	2	E1 Tip, Transmit data
13B	27	E1 Ring, Transmit data
14A	3	Alarm out, normally open
14B	28	Alarm out, common
15A	4	Alarm out, normally closed
15B	29	No connection
16A	5	No connection

Table 38
Line-side E1 card – LEI backplane and I/O panel pinouts (Part 2 of 2)

Backplane connector pin	I/O Panel connector pin	Signal
16B	30	Away from MMI terminal, receive data
17A	6	Away from MMI terminal, transmit data
17B	31	Toward MMI terminal, transmit data
18A	7	Toward MMI terminal, receive data
18B	32	Daisy chain control 2
19A	8	Daisy chain control 1
19B	33	Ground

Table 39 shows the pin assignments from the I/O panel relating to the pin assignments of the Line-Side E1 I/O cable.

Table 39
Line-side E1 card – Line-Side E1 I/O cable pinouts (Part 1 of 2)

I/O Panel Connector Pin	Lead Designations	LEI Connector Pin	LEI Cable Connector to External Equipment
1 (A2/B)	E1 Tip Receive data	11	DB15 male to E1 (P2). LEI is CPE transmit and receive to network
26 (B/A)	E1 Ring Receive data	3	
2 (A/B)	E1 Tip Transmit data	1	
27 (B/A)	E1 Ring Transmit data	9	2 y 4 Tierra (Carcasa)
3	Alarm out, common	1	
28	Alarm out (normally open)	2	DB9 male to external alarm (P3)

Table 39
Line-side E1 card – Line-Side E1 I/O cable pinouts (Part 2 of 2)

I/O Panel Connector Pin	Lead Designations	LEI Connector Pin	LEI Cable Connector to External Equipment
4	Alarm out (normally closed)	3	
7	Toward MMI terminal, receive data	2	
31	Toward MMI terminal, transmit data	3	DB9 male toward MMI (P5). Wired as DCE. Data is transmitted on pin 2 (RXD) and received on pin 3 (TXD)
33	Ground	5	
8	Control 1	7	
32	Control 2	9	
33	Ground	5	
8	Control 1	7	
32	Control 2	9	DB9 female away from MMI terminal (P4)
30	Away from MMI terminal, transmit data	3	
6	Away from MMI terminal, receive data	2	

E1 Connections

For twisted-pair installations, E1 signaling for all 30 channels is transmitted over P2 connector pins 1, 3, 9, and 11, as shown in Table 39 on page 148.

Plug the DB 15 male connector labeled "P2" into the E1 link. E1 transmit and receive pairs must be turned over between the LEI and the CPE that is hardwired without carrier facilities. If the LEI is connected through E1 carrier facilities, the transmit and receive pairs must be wired straight through to the RJ48 at the Telco demarc, the LTU, or other E1 carrier equipment. The E1 CPE at the far-end will likewise have transmit and receive wired straight from the RJ48 demarc at the far-end of the carrier facility.

For 75 ohm coaxial installations, E1 signaling for all 30 channels is transmitted over P2 connector pins 1, 3, 9, and 11 though an adapter and out two coaxial connectors Tx (transmit) and Rx (receive). Tx is the LEI output, and Rx is the LEI input from the E1 stream. E1 transmit and receive pairs must be turned over between the LEI and the CPE that is hardwired without carrier facilities. If the LEI is connected through E1 carrier facilities, the transmit and receive pairs must be wired straight through to the RJ48 at the Telco demarc, the LTU, or other E1 carrier equipment. The E1 CPE at the far end will likewise have Tx and Rx wired straight from the RJ48 demarc at the far end of the carrier facility.

External Alarm Connections

P3 connector pins 1, 2 and 3 can be plugged into any external alarm-sensing hardware. Plug the DB9 male connector labeled "P3" into an external alarm. These connections are optional, and the LEI functionality is not affected if they are not made.

The MMI monitors the E1 link for specified performance criteria and reports on problems detected. One of the ways it can report information is through this external alarm connection. If connected, the LEI's microprocessor will activate the external alarm hardware if it detects certain E1 link problems it has classified as alarm levels 1 or 2. See "Man-Machine E1 maintenance interface software" on page 155 for a detailed description of alarm levels and configuration. If an alarm level 1 or 2 is detected by the MMI, the LEI will close the contact that is normally open, and will open the contact that is normally closed. The MMI command "Clear Alarm" will return the alarm contacts to their normal state.

MMI Connections

P5 connector pins 2, 3, 5, 7 and 9 are used to connect the LEI to the MMI terminal, connecting LEIs in a daisy chain for access to a shared MMI terminal. When logging into a LEI, "control 2" is asserted by that card, which informs all of the other cards not to talk on the bus, but rather to pass the data straight through. The pins labeled "control 1" are reserved for future use. As with the external alarm connections, MMI connections are optional. Up to 128 LEIs can be linked, located in up to 16 separate IPE shelves, to one MMI terminal using the daisy chain approach.

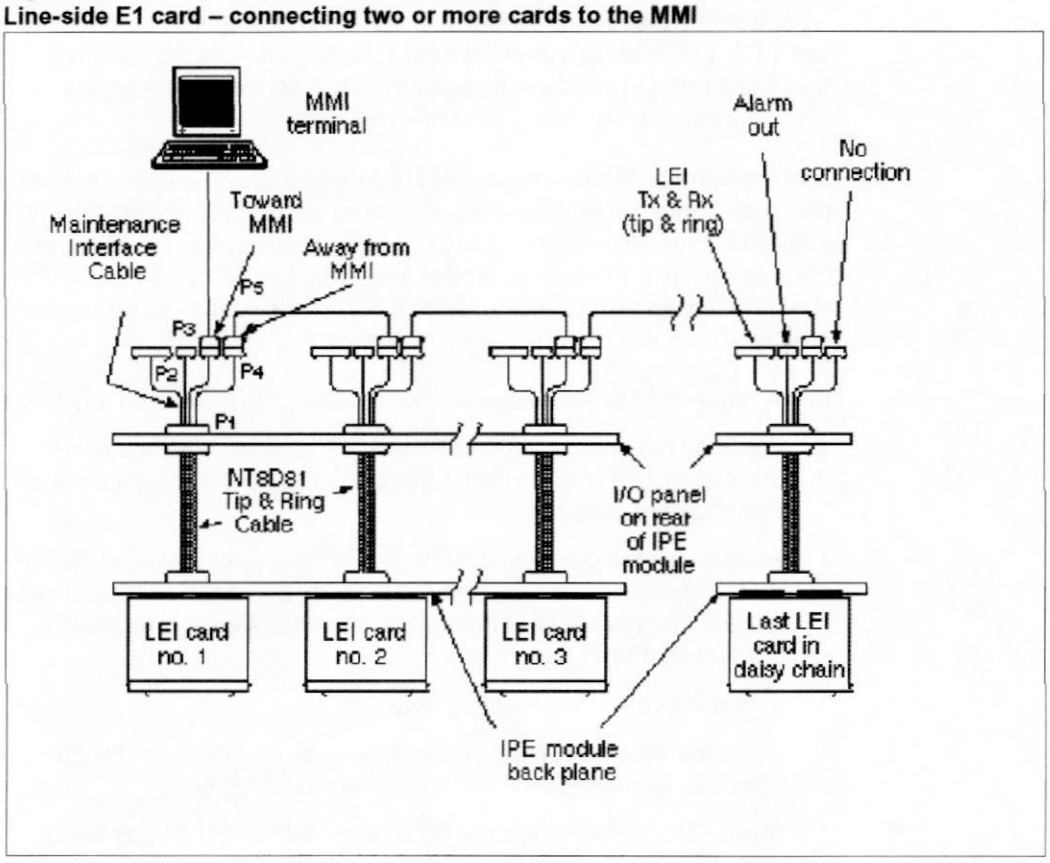
If only ***one*** LEI is will be installed, cable from the DB9 male connector labeled "P5" (toward MMI terminal) to one of the COM ports on the back of any TTY, a PC running a terminal emulation program, or a modem. For installations of only one card, no connection is made to the DB9 female connector labeled "P4" (away from MMI terminal).

If ***two or more*** LEIs are being installed into the Meridian 1 system, the MMI port connections can be daisy-chained together so that only one MMI terminal is required for up to 128 LEIs. See Figure 30 on page 152. Cards can be located in up to 15 separate IPE shelves. Start with any card slot in the IPE shelf and connect to any other card slot. Connected card slots do not need to be consecutive.

Follow this procedure for connecting two or more LEIs to the MMI terminal:

1. Cable the DB9 male connector labeled "P5" (toward MMI terminal) to one of the COM ports on the back of any TTY, a PC running a terminal emulation program, or a modem.
2. Make the connection from the first card to the second card by plugging the DB9 female connector labeled "P4" (away from MMI terminal) from the *first* card into the DB9 male connector of the second card labeled "P5" (toward MMI terminal).
3. Repeat step 2 for the remaining cards.
4. At the last card of the daisy chain, make no connection from the DB9 female connector labeled "P4" (away from MMI terminal).
5. If two LEIs are too far apart to connect the "P4" and "P5" connectors connect them with an off-the-shelf DB9 female to DB9 male straight-through extension cable, available at any PC supply store.

Figure 30
Line-side E1 card – connecting two or more cards to the MMI



Terminal configuration

For the MMI terminal to be able to communicate to the LEI, the interface characteristics must be set to:

- speed – 1200 or 2400 bps
- character width – 7 bits
- parity bit – mark

- stop bits – one
- software handshake (XON/XOFF) – off

Software Configuration

Although much of the architecture and many features of the LEI card are different from the analog line card, the LEI has been designed to emulate an analog line card to the Meridian 1 software. Because of this, the LEI software configuration is the same as for two adjacent analog line cards.

All 30 E1 channels carried by the LEI are individually configured using the analog (500/2500-type) Telephone Administration program LD 10. Use Table 39 on page 148 to determine the correct unit number and *Administration* (553-3001-311) for LD 10 service-change instructions.

LEI circuitry routes 16 units (0 – 15) on the motherboard and 14 (0 – 13) units on the daughterboard to 30 E1 channels. The motherboard circuit card is located in the left card slot, and the daughterboard circuit card is located in right card slot. For example, if installing the LEI into card slots 0 and 1, the motherboard would reside in card slot 0 and the daughterboard would reside in card slot 1. In order to configure the terminal equipment through the switch software, the E1 channel number will need to be cross-referenced to the corresponding card unit number. This mapping is shown in Table 40.

Table 40
Card unit number to E1 channel mapping (Part 1 of 2)

TN		E1 Channel Number
Motherboard	0	1
Motherboard	1	2
Motherboard	2	3
Motherboard	3	4
Motherboard	4	5
Motherboard	5	6
Motherboard	6	7
Motherboard	7	8

Table 40
Card unit number to E1 channel mapping (Part 2 of 2)

TN		E1 Channel Number
Motherboard	8	9
Motherboard	9	10
Motherboard	10	11
Motherboard	11	12
Motherboard	12	13
Motherboard	13	14
Motherboard	14	15
Motherboard	15	17
Daughterboard	0	18
Daughterboard	1	19
Daughterboard	2	20
Daughterboard	3	21
Daughterboard	4	22
Daughterboard	5	23
Daughterboard	6	24
Daughterboard	7	25
Daughterboard	8	26
Daughterboard	9	27
Daughterboard	10	28
Daughterboard	11	29
Daughterboard	12	30
Daughterboard	13	31

Disconnect supervision

The LEI supports far-end disconnect supervision by opening the tip side toward the terminal equipment upon the Meridian 1 system's detecting a disconnect signal from the far-end on an established call. The Supervised Analog Line feature (SAL) must be configured in LD 10 for each LEI port. At the prompt FTR respond:

OSP <CR>

Against FTR respond:

ISP <CR>

The LEI treats OSP and ISP for both originating and terminating calls as hook flash disconnect supervision, also known as cut-off disconnect. Originating calls are outgoing from the terminal equipment. Terminating calls are incoming to the terminal equipment. The LEI does not support battery reversal answer and disconnect supervision on originating calls.

After the software is configured, power-up the card and verify the self-test results. The **STATUS** LED on the faceplate indicates whether or not the LEI has successfully passed its self test, and is, therefore, functional. When the card is installed, this LED remains lit for two to five seconds as the self-test runs. If the self-test completes successfully, the LED flashes three times and remains lit. When the card is configured and enabled in software, the LED goes out. The LED will go out if either the motherboard or daughterboard is enabled by the software. If the LED continually flashes or remains weakly lit, replace the card.

Man-Machine E1 maintenance interface software

Description

The Man-Machine Interface (MMI) provides E1-link diagnostics and historical information for the LEI system. See "Installation and Configuration" on page 137 for instructions on how to install the cabling and configure the terminal for the MMI. The following sections will describe the options available through the LEI's MMI terminal and will explain how to set-up, configure, and use the MMI.

The MMI provides the following maintenance features:

- configurable alarm parameters
- E1-link problem indicator
- current and historical E1-link performance reports
- E1 verification and fault isolation testing
- configuration of A\B bits (North American Standard, Australian P2, or customized settings are available)

Alarms

The MMI may be used to activate alarms for the following E1-link conditions:

- excessive bit-error rate,
- frame-slip errors,
- out-of-frame,
- loss-of-signal, and
- blue alarm.

Pre-set thresholds and error durations trip LEI alarm notifications. For descriptions of each of these E1-link alarm conditions, see "Performance counters and reporting" on page 176. For instructions on how to set alarm parameters, see "Set Alarm" on page 162. For information on accessing alarm reporting, see "Display Alarms" on page 174, "Display Status" on page 175 and "Display Performance" on page 177.

Two levels of alarm severity exist for bit errors. Different threshold and duration settings must be established for each level.

When the first level of severity is reached (alarm level 1), the MMI causes the following:

- the external alarm hardware activates t
- he RED ALARM LED on the faceplate will be lit

- an alarm message will be displayed on the MMI terminal
- an entry will be created in the alarm log and printed to the MMI port

When the second level of severity is reached (alarm level 2), the MMI will perform all functions performed at alarm level 1,. In addition, the LEI enters line-conditioning mode. In this mode, the LEI sends either "on-hook" or "off-hook" signals for all 30 ports to the Meridian 1, depending on how the dip switch for line processing is set (dip switch 2, position 6). See Table 36 on page 143.

If the MMI detects E1-link failures for any of the other conditions monitored (out-of-frame, excess frame slips, loss-of-signal, and blue alarm condition), the LEI automatically performs all alarm level 2 functions. The MMI also sends a yellow alarm to the far-end LTU. Alarms may be set to self-clear when the alarm condition is no longer detected. See "Set Clearing" on page 166.

All alarms activated produce a record in the alarm log. The alarm log maintains records for the most recent 100 alarms, and can be displayed, printed, and cleared. The alarm log displays or prints the alarms in descending chronological order, beginning with the most recent alarm. Notifications in the alarm log include the date and time of the alarm's occurrence.

E1 Performance Counters and Reports

The MMI maintains performance error counters for the following E1 conditions:

- errored seconds
- bursty seconds
- unavailable seconds
- framer-slip seconds
- loss-of-frame seconds

The MMI retains E1 performance statistics for the current hour, and for each hour for the previous 24. For descriptions of these performance error counters and instructions on how to create a report on them and clear them, see "Performance counters and reporting" on page 176.

E1 Verification and Fault Isolation Testing

The MMI enables various tests to be performed that either verify that the E1 is working adequately, or help to isolate a problem to the LEI, the E1 link, or the CPE. For descriptions of all of these tests and instructions on how to run them, see "Testing" on page 179.

Login and Password

The MMI can be accessed through any TTY, PC running a terminal emulation program, or modem. After installing the MMI terminal and card cables, the MMI can be configured.

For single-card installations, it is accessed by entering **L<CR>** to login.

For multiple-card installations connected in a daisy chain, it is accessed by entering **L <address>**, where the four-digit address is a combination of the two-digit address of the IPE shelf as set by dip switch positions on the card Switch 1, positions 3-6, plus the address of the card slot the motherboard occupies. See Table 37, "Line-side E1 card – NT8D37 IPE Module vintage level port cabling," on page 144.

For example, to login to a card located in shelf 13, card slot 4, type:

L 13 4 <CR>

Spaces are inserted between the login command (L), the shelf address, and the card slot address.

The MMI prompts for a password. The password is "**LEILINK**," and it must be typed in all capital letters.

After logging in, the prompt looks like this:

LEI::> (for single-card installations)

LEI::ss cc> (for multi-card installations, where ss represents the shelf address and cc represents the card slot address.)

Basic commands

MMI commands can now be executed. The seven basic commands are:

- Help
- Alarm
- Clear
- Display
- Set
- Test
- Quit

Type **? <CR>** to list these commands, along with an explanation of their usage. A screen similar to Figure 31 will appear. The help screen will also appear by typing **H<CR>**, or **HELP<CR>**.

Figure 31
HELP (H, ?) screen

```
ALARM   USAGE: Alarm [Enable | Disable]
CLEAR   USAGE: Clear [Alarm] | [Error counter] [Log]
DISPLAY USAGE: Display [Alarm | Status | Perform | History] [Pause]
HELP    USAGE: Help | ?
SET     USAGE: Set[Time | Date | Alarm | Clearing | Name Memory | Mode | Simple]
TEST    USAGE: Test [Carrier All]
QUIT    USAGE: Quit

Notation Used:
CAPS - Required Letters       [ ] - Optional | - Either/Or
```

Each of these commands can be executed by entering the first letter of the command or by entering the entire command. Commands with more than one word are entered by entering the first letter of the first word, a space, and the first letter of the second word or by entering the entire command. Table 41 shows all possible MMI commands in alphabetical order. These commands are also described later in this section.

Table 41
MMI commands and command sets (Part 1 of 2)

Command	Description
A D	**Alarm Disable.** Disables all alarms.
A E	**Alarm Enable**. Enables all alarms.
C A	**Clear Alarm.** Clears all alarms, terminates time processing, and resets the E1 bit error rate and frame slip counters.
C A L	**Clear Alarm Log**. Clears alarm log.
C E	**Clear Error**. Clears the E1 error counter.
D A(P)	**Display Alarms**. Displays the alarm log, which is a list of the 100 most recent alarms with time and date stamps. (Momentarily stop the scrolling display by typing P. Continue scrolling by typing any other key.)
D C(P)	**Display Configuration**. Displays the configuration settings for the LEI(s), single- or multiple-card system. Display includes each card's serial number, MMI firmware version, date and time, alarm diable/enable setting, self-clearing diable/enable setting, values entered through the Set Configuration command, and dip switch settings.(Momentarily stop the scrolling display by typing P. Continue scrolling by typing any other key.)
D H(P)	**Display History**. Displays performance counters for the past 24 hours. (Momentarily stop the scrolling display by typing P. Continue scrolling by typing any other key.)
D P	**Display Performance**. Displays performance counters for the current hour.
D S(P)	**Display Status**. Displays carrier status, including alarm state and, if active, alarm level. (Momentarily stop the scrolling display by typing P. Continue scrolling by typing any other key.)
H or ?	**Help**. Displays the Help screen.

Table 41
MMI commands and command sets (Part 2 of 2)

Command	Description
L	**Login**. Logs into the MMI terminal in a single-LEI system.
Lxx	**Login**. Logs into the MMI terminal in a daisy-chained system, where *xx* represents the address of the card to be configured.
Q	**Quit**. Logs out of the MMI terminal. ***Note:*** If it is a daisy-chained system, be certain to log out when finished with configuration. In a daisy-chained system, only one card may occupy the bus at a given time and all other LEIs will be unable to notify the MMI of alarms unless logged-out of configuration mode.
S A	**Set Alarm**. Sets alarm parameters, such as the allowable bit-errors per second, threshold, and alarm duration.
S C	**Set Clearing**. Sets the alarm self-clearing function, "enable" or"disable."
S D	**Set Date**. Sets the date or verifies the current date.
S M	**Set Mode**. Sets the A/B Bits mode.
S S	**Set Simple**. Sets whether or not the LEI waits for the terminal equipment to return an idle-state message before returning the channel to idle at call disconnect from the far-end.
S T	**Set Time**. Sets the time or verifies current time.
T	**Test**. Initiates the E1 carrier test function. To terminate a test in-process, enter the STOP TEST command at any time.

Configuring parameters

The MMI has been designed with default settings so that no configuration is necessary. However, it can be configured based on the call environment.

Set Time

Before beginning to configure the MMI, login to the system and verify the current time. Do this by entering the **`Set Time (S T)`** command. The MMI displays the time it has registered. Enter a new time or hit **`Enter`** to leave it unchanged. The time is entered in the "hh:mm:ss," the 24-hour, or military, format.

Set Date

Verify the current date. Do this by entering the **`Set Date (S D)`** command. The MMI then displays the date it has registered. Enter a new date or hit **`Enter`** to leave it unchanged. The date is entered in the "mm/dd/yy" format.

Set Alarm

The **`Set Alarm (S A)`** command sets the parameters by which an alarm is activated and the duration of the alarm after it is activated. There are three alarm levels as described below:

- **Alarm Level 0 (AL0)** consists of activity with an error threshold below the AL1 setting, which is a satisfactory condition and no alarm is activated.
- **Alarm Level 1 (AL1)** consists of activity with an error threshold above the AL1 setting, but below the AL2 setting that is deemed to be of minor importance. In this situation, the external alarm hardware is activated by closing the normally open contact, the RED ALARM LED on the faceplate lights, and an alarm message is created in the alarm log and the MMI terminal.
- **Alarm Level 2 (AL2)** consists of activity with an error threshold above the AL2 setting which is deemed to be of major importance. In this situation, the following happens:
  - the external alarm hardware is activated by closing the normally open contact
  - the RED ALARM LED on the faceplate lights
  - an alarm message is created in the alarm log and the MMI terminal
  - the Line-side E1 card enters line-conditioning mode
  - a yellow alarm message is sent to the CPE/LTU

Line processing sends the Meridian 1 either all "on-hook" or all "off-hook" signals, depending on the dip switch setting of the card. See Table 36, "Line-side E1 card – E1 Switch 2 (S2) dip switch settings," on page 143.

When the **Set Alarm** command is selected, the prompt appears for setting the threshold level and duration for alarm levels 1 and 2.

The E1 link processes at a rate of approximately 2.0 mb/s. The threshold value indicates the ratio of the total number of bits that must be detected as being in error per second before the LEI activates an alarm. It can be set between 3 and 9 and can be different for each alarm level. Any other value entered will cause the MMI to display a `"Parameter Invalid"` message. The digit entered as the threshold value is a number representing a negative power of 10 as shown in Table 42 on page 163.

> ***Note:*** The error-rate threshold for a level 2 alarm must be greater (a smaller power of 10) than for a level 1 alarm. Remember that the numbers being represented are negative numbers. Since 3 represents –3, and 4 represents –4, 4 represents a smaller number than 3 does.

Table 42
E1 bit error rate threshold settings

Alarm threshold bit errors per second in power of 10	Threshold to set alarm	Allowable Duration Periods
10^{-3}	2,000/ second	1-21 seconds
10^{-4}	200/second	1-218 seconds
10^{-5}	20/second	1-2148 seconds
10^{-6}	2.0/second	1-3600 seconds
10^{-7}	2.0/10 seconds	10-3600 seconds
10^{-8}	2.0/100 seconds	100-3600 seconds
10^{-9}	2.0/1000 seconds	1000-3600 seconds

The duration value is set in seconds and can be set from 1 to 3,600 seconds (1 hour). This duration value indicates how long the alarm condition must last before an alarm will be declared. Low bit-error rates (10^7 through 10^9) are restricted to longer durations since it takes more than one second to detect an alarm condition above 10^6. Higher bit-error rates are restricted to shorter durations because the MMI error counter fills at 65,000 errors.

The alarm indications (LEDs and external alarm contacts) will clear automatically after the specified period, or duration, has expired if the **Set Clearing (S C)** "Enable Self Clearing" option has been set. Otherwise, the alarm will continue until the command **Clear Alarm (C A)** has been entered.

- When an alarm is cleared, all activity caused by the alarm indications is cleared:
- the external alarm hardware is deactivated (the contact normally open will be reopened),
- the LED goes out,
- an entry is made in the alarm log of the date and time the alarm was cleared, and
- carrier-fail line supervision ceases (for alarm level 2 only).

If self-clearing alarm indications have been disabled, carrier-fail line supervision terminates when the alarm condition has ceased, but the external alarm contact and faceplate LED remain active until the alarm is cleared.

A heavy bit-error rate can cause 200 bit errors to occur much more quickly than100 seconds. This causes the alarm to be declared sooner.

An alarm condition is not automatically cleared until the system no longer detects the respective bit error threshold during the corresponding duration period.

For example, if AL1 threshold of 6 (representing 10-6) is specified, and a duration period of 100 seconds is specified, an alarm is activated if more than 200 bit errors occur in any 100 second period. As soon as the alarm is activated, the bit counter is reset to 0. If the next 100 seconds pass, and less than 200 bit errors are detected, then the alarm cleasr after the alarm's duration period. However, if more than 200 bit errors are detected in the next 100 seconds, the alarm condition continues for the designated time period.

The alarm finally clears when the alarm condition is no longer detected for the designated period, either by self-clearing (if this function is enabled), or when the **Clear Alarm (C A)** command is entered.

In addition to bit errors, the Set Alarm function sets parameters for detecting frame-slip errors by establishing a threshold necessary to activate an alarm. If the threshold value is exceeded, a level 2 alarm is activated. The frame slip threshold can be specified from 1 to 255 frame slips per time period. The duration time period can be specified from 1 to 24 hours.

When entering the **Set Alarm (S A)** command, the MMI scrolls through the previously described series of alarm options. These options are displayed along with their current value, at which point a new value can be entered or enter **<CR>** to retain the current value. Table 43 outlines the options available in the **Set Alarm (S A)** function.

Table 43
Set alarm options

Option	Description
AL1 Threshold	Sets the allowable bit errors per second before alarm level 1 is activated. Factory default is 6.
AL1 Duration	Sets the duration in seconds (from 1 to 3,600 seconds) that alarm level 1 is activated. Factory default is 10 seconds.
AL2 Threshold	Sets the allowable bit errors per second (from 3 to 9) before alarm level 2 is activated. Factory default is 10^{-5}.
AL2 Duration	Sets the duration in seconds (from 1 to 3,600 seconds) that alarm level 2 is activated. Factory default is 10 seconds.
Frame Slip Threshold	Sets the allowable frame slips per time period (from 1 to 255) before alarm level 2 is activated. Factory default is 5.
Frame Slip Duration	Sets the duration in hours (from 1 to 24) that the frame slips are counted. After this time period, the counter is reset to 0. Factory default is 2 hours.

Note: If the duration period set is too long, the Line-side E1 card is slow to return to service automatically even when the carrier is no longer experiencing errors. The **CLEAR ALARM (C A)** command has to be entered manually to restore service promptly. To avoid this, an alarm's duration period is normally set to 10 seconds.

Set Clearing

The **SET CLEARING (S C)** command allows self-clearing of alarms by responding to the question: **Enable Self Clearing? (YES or NO)**. If **YES** is chosen (the factory default setting), the system automatically clears (resets) alarms after the alarm condition is no longer detected. Choosing the **NO** option causes the system to continue the alarm condition until the **Clear Alarm (C A)** command is entered. Line processing and yellow alarm indication to the CPE terminates as soon as the alarm condition clears, even if self-clearing is disabled.

Set Simple

The **SET SIMPLE** command controls call tear-down signaling when the far-end disconnects from a call. Release 2 of the AB vintage introduces this feature.

When the far-end terminates a call, Release 1 of LEI's AB vintage sends a disconnect message to the terminal equipment and waits for the terminal equipment to go idle before going idle itself. A **NO** response to the **S S** command configures Release 2 (and later) boards to operate in this way. See Figure 32 on page 166.

Release 2 of AB vintage LEIs gives the administrator the option of using the signaling described above, or configuring the LEI to take its channel idle immediately after sending the call-disconnect message. A **YES** response to the **S S** command, the default configuration for Release 2 (and later) boards, configures the LEI to operate in this way. See Figure 33 on page 167.

Figure 32
Set Simple (S S) no screen

```
LEI::>S S
Enable Simplified Call Tear Down? (YES or NO)N
Simplified Call Tear Down Disabled.
LEI::>
```

Figure 33
Set Simple (S S) yes screen

```
LEI::>S S
Enable Simplified Call Tear Down? (YES or NO)Y
Simplified Call Tear Down Enabled.
LEI::>
```

Set Mode

At the **SET MODE (S M)** command, the MMI prompts the user with the current signaling mode, either Default (Australian P2) or Table (of bit values.) Entering a **<CR>** accepts the current value, or the user can type in 1 to revert to the Default, or 2 to edit the table entries. See Figure 34 on page 167. If the user selects default, then the A/B Bit values is reset to the Default values.

Figure 34
Set Mode (S M): <CR> screen

```
LEI:>S M
1) Default
2) Table
Hit <CR> to accept current value or type in a new one.
Current Mode : 1              New Mode :
Signaling Bits set to Default.

LEI:>
```

Responding to the MMI's **Set Mode** prompt with "**1**" also results in the line, "**Signaling Bits set to Default,**" as in Figure 34 on page 167.

However, responding to this prompt with **2** selects "Table" and allows the user to set the A/B Bit Mode to whatever configuration the user chooses.

If "Table" is selected, the individual table values will is prompted for. See Figures 35 on page 169 and Figure 36 on page 170. After each value is displayed, enter **<CR>** to do the following:

- accept the current value
- enter just the AB bits (which will be copied to the CD bits)

- enter a complete ABCD bit pattern
- in the case of optional states, a 'N' or 'n' can be entered to indicate that the state is not needed

Note that in D4 Framing for E1, there are no CD bits, so they will be ignored.

The user is prompted for ABCD bit values for the following states when the table mode is selected.

Send and Receive refer to the LEI sending ABCD bits to the CPE (Customer Provided Equipment) or receiving ABCD bits from the CPE.

Incoming and Outgoing refer to E1 digital link from the CPE point of view. Incoming is thus an external call arriving over the digital link and accepted by the CPE. Outgoing is a call originated by the CPE over the digital link.

Configuring the A/B Bit Signaling table is illustrated in Figures 35 on page 169 and Figure 36 on page 170.

Figure 35
Set Mode (S M): Table screen (Part One)

```
LEI:>S M
1) Default
2) Table
Hit <CR> to accept current value or type in a new one.
Current Mode : 1          New Mode : 2
Signaling Bits set to Table.

Incoming and outgoing calls are in reference to the CPE.
All ABCD bits are with respect to SENDing from LEI/M1 to CPE
or RECEIVing from CPE to LEI/M1.
Please enter new ABCD bits or hit <CR> to accept.  You may
enter 2 or 4 values.  If only 2 values are entered, the A and
B bits will be copied to the C and D bits.

IDLE SEND:  Current: 0000  New: 0101
IDLE SEND bits changed to: 0101

IDLE RECEIVE:  Current: 0101  New:
IDLE RECEIVE bits unchanged.

BLOCKING RECEIVE enabled? (Y/N): N
BLOCKING RECEIVE is disabled.

Incoming call RINGER-ON SEND:  Current: 0000  New:
Incoming call RINGER-ON SEND bits not changed.

Incoming call RINGER-OFF SEND:  Current: 0101  New: 0101
Incoming call RINGER-OFF SEND bits not changed.

Incoming call OFFHOOK RECEIVE:  Current: 1111  New: 11
Incoming call OFFHOOK RECEIVE bits not changed.

Incoming call CONNECTED SEND:  Current: 0101  New:
Incoming call CONNECTED SEND bits not changed.

Incoming call (Far End) DISCONNECT SEND:  Current: 1111  New:
Incoming call (Far End) DISCONNECT SEND bits not changed.

Incoming call (CPE) DISCONNECT RECEIVE:  Current: 0101  New:
Incoming call (CPE) DISCONNECT RECEIVE not changed.
```

Figure 36
Set Mode (S M): Table screen (Part Two)

```
Outgoing call SEIZE RECEIVE:  Current: 0001  New: 111
Error: Note enough values specified.  Enter either 2 or 4
values.
Outgoing call SEIZE RECEIVE:  Current: 0001  New: 11
Outgoing call SEIZE RECEIVE bits changed to: 1111

Outgoing call SEIZE ACK SEND enabled? (Y/N): N
Outgoing call SEIZE ACK SEND is disabled.

Outgoing call DIAL MAKE RECEIVE:  Current: 1111  New:
Outgoing call DIAL MAKE RECEIVE bits not changed.

Outgoing call DIAL BREAK RECEIVE:  Current: 1010  New:
Outgoing call DIAL BREAK RECEIVE bits not changed.

Outgoing call ANSWERED SEND:  Current: 0101  New:
Outgoing call ANSWERED SEND bits not changed.

Outgoing call (CPE) DISCONNECT RECEIVE:  Current: 0101  New:
Outgoing call (CPE) DISCONNECT RECEIVE bits not changed.

Outgoing call (Far End) DISCONNECT SEND:  Current: 1111  New:
Outgoing call (Far End) DISCONNECT SEND bits not changed.

Disconnect Time (0 to 4000 ms): 1000
Disconnect Time not changed.

Intercall Time (0 to 2000 ms): 800
Intercall Time not changed.

LEI:>
```

Idle SEND – This is the value that the LEI sends (acting as the CO or PSTN) when the circuit is in the idle state. This value is required.

Idle RECEIVE – This is the value that the LEI expects to see from the CPE when it is in the idle state. This value is required.

Blocking RECEIVE – This is the value that the LEI expects to see from the CPE when the customer equipment is in the blocking or fault state and is unable to accept new calls. Set this value to N if this state is not needed. If this value is not set to N, then dip switch #2 position 6 will determine whether off-hook or on-hook is sent to the M1/SL100 when this state is entered. See Table 36 on page 143.

Incoming call Ringer ON SEND – This is the value that the LEI sends to indicate that a call is incoming to the CPE and that ringing voltage should be applied at the CPE. This value is required.

Incoming call Ringer OFF SEND – This is the value that the LEI sends to indicate that a call is incoming to the CPE and that the ring cycle is in the off portion of the cadence. This value is required.

Incoming call Offhook RECEIVE – This is the value that the LEI expects to see from the CPE when the customer equipment has gone to an off hook state which indicates that the incoming call has been answered. This value is required.

Incoming call CONNECTED SEND – This is the value that the LEI sends to the CPE to indicate that it has seen and recognized the off hook indication sent by the CPE. The call is considered fully connected at this point. This value is required.

Incoming call (Far-end) DISCONNECT SEND – This is the value that the LEI sends to indicate that the far-end has released the call. This value is required.

Incoming call (CPE) DISCONNECT RECEIVE – This is the value that the LEI expects to see from the CPE when the customer equipment wishes to end the call. This value is required.

Outgoing call SEIZE RECEIVE – This is the value that the LEI expects to see when the CPE goes to an off hook condition and wishes to initiate a call. This value is required.

Outgoing call SEIZE ACK SEND – This is the value that the LEI will send to indicate that the seized condition has been noted and the M-1 is ready for dial digits. This value can be set to N if it is not required such as in a loop start case.

Outgoing call DIAL MAKE RECEIVE – This is the value that the LEI expects to see from the CPE during the make part of the digit. This value is required.

Outgoing call DIAL BREAK RECEIVE – This is the value that the LEI expects to see from the CPE during the break part of the digit. This value is required.

Outgoing call ANSWERED SEND – This is the value that the LEI will send to indicate that the far-end has answered the call. This value is required.

Outgoing call (CPE) DISCONNECT RECEIVE – This is the value that the LEI expects to see from the CPE when the customer equipment wishes to end the call. This value is required.

Outgoing call (Far-end) DISCONNECT SEND – This is the value that the LEI will send to indicate that the far-end has released the call This value is required.

Disconnect Time – This is the number of milliseconds that the LEI will send the disconnect signal to the CPE before reverting to the idle state. If the CPE reverts to a connected state during this time, it is ignored. This value is only used when disconnect supervision is available and is needed for the signaling type in use. It is used when the far-end initiates the disconnect. For loop start cases, this value is not used.

Intercall (release guard) Time – This is the number of milliseconds that the LEI maintains the idle signal to the CPE before initiating a new call. The CPE should not initiate a new call during this time. If it does so, the off-hook indication is ignored until the release guard time has expired. This value defaults to 0 which relies on the M-1 to observe the proper guard time. If a non-zero value is entered, off-hook from the CPE and Ringer-On commands from the M1/SL100 is ignored until this timer has expired.

Display Configuration (D C)

The **Display Configuration (D C)** command displays the various configuration settings established for the LEI. Entering this command causes a screen similar to Figure 37 on page 173 to appear:

Figure 37
Display Configuration (D C) screen

```
LEI  S/N 1103  Software Version 1.01    3/03/95  1:50
Alarms Enabled:  YES     Self Clearing Enabled:  YES
Alarm Level 1 threshold value:  E-7      Threshold duration (in
seconds):  10
Alarm Level 2 threshold value:  E-5      Threshold duration (in
seconds):  1
Frame slips alarm level threshold:  5    Threshold duration (in hours)
2
Current dip switch S1 settings (S1..S8)  On Off Off On Off Off Off On
Current dip switch S2 settings (S1..S8)  On Off On Off Off Off On Off
```

Alarm operation and reporting

The MMI monitors the E1 link according to parameters established through the Set Alarm command for the following conditions:

- Excessive bit error rate
- Frame slip errors
- Out of frame condition
- Loss of signal condition
- Blue alarm (AIS) condition

Descriptions of the excessive bit error rate and frame slip errors conditions are found in "Configuring parameters" on page 161. Bit errors activate either a level 1 or level 2 alarm. The remaining conditions, when detected, always cause the system to activate a level 2 alarm.

An out-of-frame condition will be declared if 3 consecutive frame bits are in error. If this condition occurs, the hardware immediately attempts to reframe. During the reframe time, the E1 link is declared out-of-frame, and silence is sent on all receive timeslots.

A loss of signal condition is declared if a full frame (255 bits) of consecutive zeros has been detected at the receive inputs. If this condition occurs, the E1 link automatically attempts to resynchronize with the far-end. If this condition lasts for more than two seconds, a level 2 alarm is declared, and silence is sent on all receive timeslots. The alarm is cleared if, after two seconds, neither a loss of signal, out-of-frame condition, or blue alarm condition occurs.

If a repeating device loses signal, it immediately begins sending an unframed signal of all ones to the far-end to indicate an alarm condition. This condition is called a blue alarm, or an Alarm Indication Signal (AIS). If an AIS is detected for more than two seconds, a level 2 alarm is declared, and silence is sent on all receive timeslots. The alarm is cleared if, after two seconds, neither a loss of signal, out-of-frame condition, or blue alarm condition occurs.

Alarm Disable

The **Alarm Disable (A D)** command disables the external alarm contacts. When this command is typed, the MMI displays the message **Alarms Disabled** and the MAINT LED lights. In this mode, no yellow alarms are sent and the LEI does not enter line processing mode. Alarm messages are sent on the MMI terminal and the LED continues to indicate alarm conditions.

Alarm Enable

The **Alarm Enable (A E)** command does the reverse of the **Alarm Disable (A D)** command. It enables the external alarm contacts. When this command is typed in, the MMI will display the message **Alarms Enabled**. In this mode, yellow alarms can be sent and the LEI can enter line processing mode.

Clear Alarm

The **Clear Alarm (C A)** command clears all activity initiated by an alarm: the external alarm hardware is deactivated (the contact normally open is reopened), the LED goes out, an entry is made in the alarm log of the date and time the alarm was cleared, and line processing ceases (for alarm level 2 only). When this command is typed, MMI displays the message **Alarm acknowledged**. If the alarm condition still exists, an alarm is declared again.

Display Alarms

A detailed report of the most recent 100 alarms with time and date stamps can be displayed by entering the **Display Alarms (D A)** command into the MMI, which will cause a screen similar to Figure 38 on page 175 to appear.

Figure 38
Display Alarm (D A) screen

```
Alarm Log

 2/03/99  1:48  Yellow alarm on E1 carrier
 2/03/99  2:33  E1 carrier level 1 alarm
 2/03/99  3:47  E1 carrier level 2 alarm
 2/03/99  4:43  E1 carrier performance within thresholds
 2/03/99 15:01 Log Cleared
```

The Pause command can be used to display a full screen at a time, by entering **D A P**. If there is more than one screen in the log, the MMI scrolls the log until the screen is full, then stops. When ready to see the next screen, press any key. The display shows another screen and stops again. This continues until the entire log has been displayed.

Clear Alarm Log

Clear all entries in the alarm log by typing the **Clear Alarm Log (C A L)** command.

Display Status

The **Display Status (D S)** command displays the current alarm condition of the E1 link as well as the on-hook or off-hook status of each of the 30 ports of the LEI. Entering this command causes a screen similar to Figure 39 on page 176 to appear.

The Pause command can be used to display a full screen at a time, by entering **D S P**. If there is more than one screen, the MMI scrolls until the screen is full, then stops. When ready to see the next screen, press any key. The display shows one more screen, and stops again. This continues until the entire E1 link has been reported on.

Figure 39
Display Status (D S) screen

```
LEI  S/N   Software Version 1.01    3/03/95  1:50
In alarm state:  NO
E1 link at alarm level 0
Port 0 off hook, Port 1 on hook, Port 2 on hook, Port 3 on hook,
Port 4 on hook, Port 5 on hook, Port 6 off hook, Port 7 off hook,
Port 8 off hook, Port 9 on hook, Port 10 on hook, Port 11 on hook,
Port 12 off hook, Port 13 on hook, Port 14 on hook, Port 15 on hook,
Port 16 on hook, Port 17 on hook, Port 18 off hook, Port 19 off hook,
Port 20 off hook, Port 21 on hook, Port 22 on hook, Port 23 on hook
Port 21 off hook, Port 22 on hook, Port 23 on hook, Port 24 on hook,
Port 25 on hook, Port 26 on hook, Port 27 off hook, Port 28 off hook,
Port 29 off hook
```

Performance counters and reporting

The MMI monitors the performance of the E1 link according to several performance criteria including errored, bursty, unavailable, loss-of-frame and frame-slip seconds. It registers the performance of these criteria by reading their status every second and counting their results. These counts are accumulated for an hour, then reset to 0. Previous hour count results are maintained for each of the previous 24 hours.

The LEI counts CRC-4 errors when CRC-4 is enabled and Bipolar Violations (BPV) when CRC-4 is disabled. The performance criteria for which these counts are maintained as follows:

- Errored seconds are seconds in which one or more CRC-4 / BPV errors, or one or more out-of-frame errors in one second.
- Bursty seconds are seconds in which more than one and less than 320 CRC-4 / BPV errors in a second.
- Severely errored seconds are seconds in which more than 320 CRC-4 / BPV errors, or one or more out-of-frames in a second.
- Unavailable seconds are seconds in which unavailable state starts with 10 consecutive severely errored seconds and ends with 10 consecutive non-severely errored seconds (excluding the final 10 non-severely errored seconds).

- Loss-of-frame seconds are seconds in which loss-of-frame or loss-of-signal conditions have existed for three consecutive seconds.
- Frame slip seconds are seconds in which one or more frame slips occur.

The MMI also maintains an overall error counter which is the sum of all errors counted for the performance criteria listed above. The error counter can only be cleared by entering the **Clear Error (C E)** command. It stops counting at 65,000. The error counter provides an easy method to determine if an alarm condition has been corrected. Clear the error counter, wait a few minutes, and display the performance to see if any errors have occurred since the counter was cleared.

The MMI display reports on these performance counters through the **Display Performance (D P)** or the **Display History (D H)** commands.

Display Performance

Entering the **Display Performance (D P)** command displays performance counters for the past hour. A screen similar to Figure 40 will appear:

Figure 40
Display Performance (D P) screen

LEI E1 Interface Performance Log
3/03/95 1:37 PM

Data for the past 37 Minutes

Errored Seconds	Bursty Seconds	Unavailable Seconds	Loss Frame Seconds	Frame Slip Seconds	Error Counter
2263	0	2263	2263	352	321

Each column, except the error counter, indicates the number of errors in the current hour and is reset to zero every hour on the hour. Just before the performance counters are reset to zero, the values are put into the history log.

The error counter indicates the number of errors since the error counter was cleared.

The Pause command can be used to display a full screen at a time, by entering **D P P**. If more than one screen is to be displayed, the MMI scrolls until the screen is full, then stops. When ready to see the next screen, press any key. The display shows one more screen, and stops again. This continues until the entire display has been shown.

Display History

Entering the **Display History (D H)** command displays performance counters for each hour of the past 24 in reverse chronological order, beginning with the last full hour. A screen similar to Figure 41 will appear.

The Pause command works the same for Display History as it does for the other display commands. Simply enter `D H P` to see a report on the performance counters, one screen at a time.

Figure 41
Display History (D H) screen

LEI E1 Interface History Performance Log
1/03/99 8:37 PM

Hour Ending	Errored Seconds	Bursty Seconds	Unavailable Seconds	Loss Frame Seconds	Frame Slip Seconds	Error Count
20:00	139	0	129	139	23	162
19:00	0	0	0	0	0	0
18:00	0	0	0	0	0	0
17:00	0	0	0	0	0	0
16:00	0	0	0	0	0	0

As with all `Display` commands, the Pause command can be used to display a full screen of the history report at a time, by entering **D H P**.

Clear Error

Reset the error counter to zero by entering the Clear Error (C E) command. The error counter provides a convenient way to determine if the E1 link is performing without errors since it can be cleared and examined at any time.

Testing

The **Test Carrier (T)** command allows tests to be run on the LEI, the E1 link, or the CPE device. The three tests are designed to provide the capability to isolate faulty conditions in any of these three sources. See Table 44 on page 180 for additional information on these three test types. Enter the **T** command, and at the prompt, enter which of these three tests is to be initiated. The prompt is similar to Figure 42:

Figure 42
Test Carrier (T) screen

```
Test 1:  Local Loopback Test
Test 2:  External Loopback Test
Test 3:  Network Loopback Test
(1,2,3 or S to cancel):
```

Tests can be performed once, for one through 98 minutes, or continuously (selected by entering 99 minutes), until a **Stop Test** command is entered. Tests continue for the duration specified even if a failure occurs, and terminate at the end of the time period or when a **Stop Test** command is issued. Only **Stop Test** stops a test with a duration selection of 99; however, the **STOP** command terminates a test set to any duration from one to 99. After entering the test number, a prompt similar to Figure 43 appears.

Figure 43
Test parameters screen

```
Enter Duration of Test (1-98 Mins, 0 = Once, 99 = Forever)
Test will interfere with traffic.  Hit Q to quit or any Key to Continue
```

Before a test is run, be sure to verify that the card is disabled, as the tests interfere with calls currently in process.

During a test, if an invalid word is received, this is recorded by a failure peg counter. The peg counter has a limit of 65,000. At the end of the test, the Test Results message indicates how many failures, if any, occurred during the test.

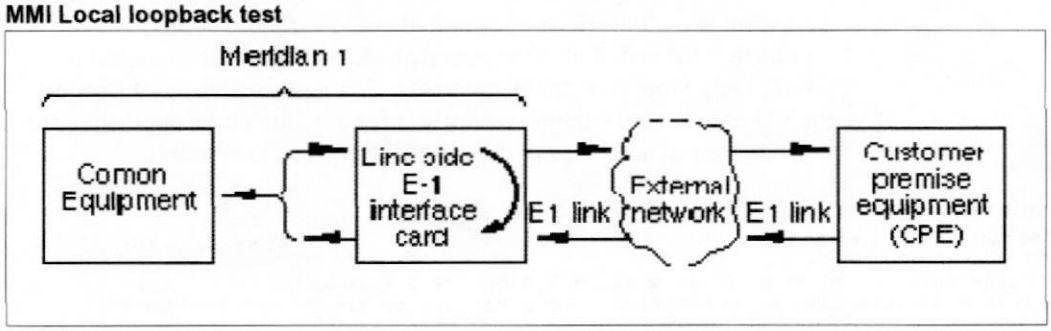
Table 44 on page 180 shows which test to run for the associated equipment:

Table 44
MMI Tests

Test number	Equipment Tested	Test Description
1	LEI	Local loopback
2	E1 link, LEI, and E1 network	External loopback
3	CPE device and E1 network	Network loopback

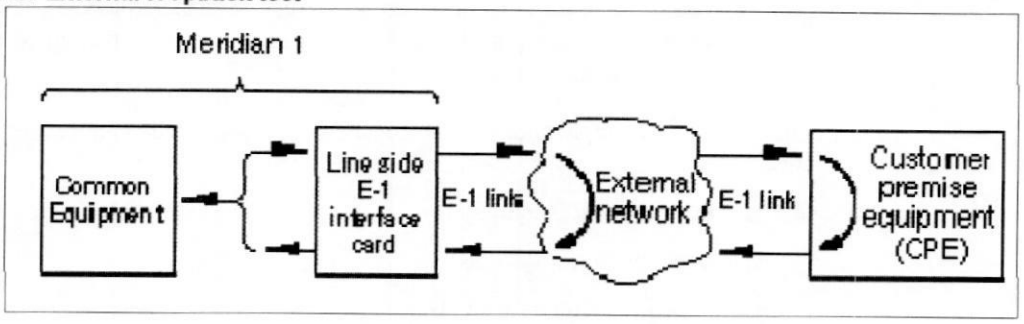
Test 1, local loopback, loops the E1 link signaling toward itself at the backplane connector. Test data is generated and received on all timeslots. If this test fails, it indicates that the LEI is defective. Figure 44 illustrates how the signaling is looped back toward itself.

Figure 44
MMI Local loopback test



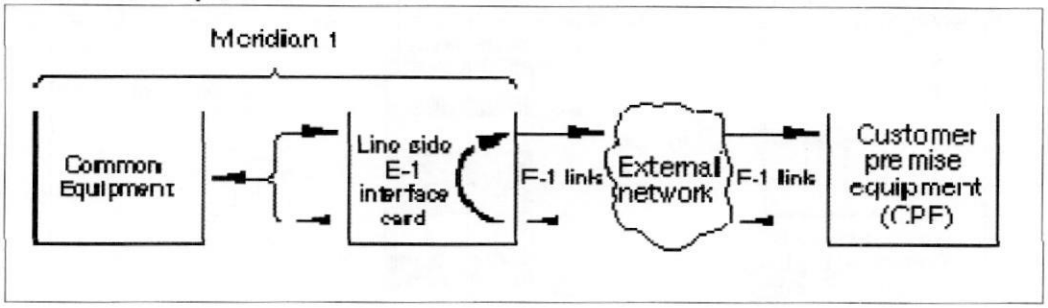
Test 2, external loopback, applies an external loopback to the E1 link. Test data is generated and received by the LEI on all timeslots. If test 1 passes but test 2 fails, it indicates that the E1 link is defective between the LEI and the external loopback location. If test 1 was not run and test 2 fails, the E1 link or the LEI could be defective. To isolate the failure to the E1 link, tests 1 and 2 must be run in tandem. Figure 45 on page 181 demonstrates how an external loopback is applied to the E1 link.

Figure 45
MMI External loopback test



Test 3, network loopback, loops the LEI's received E1 data back toward the CPE. No test data is generated or received by the LEI. If test 2 passes but test 3 fails, it indicates that the CPE device is defective. If test 2 was not run and test 3 fails, the E1 link or the CPE device could be defective. To isolate the failure to the CPE device, tests 2 and 3 must be run in tandem. Figure 46 illustrates how the signaling is looped back toward the CPE.

Figure 46
MMI Network loopback test



Applications

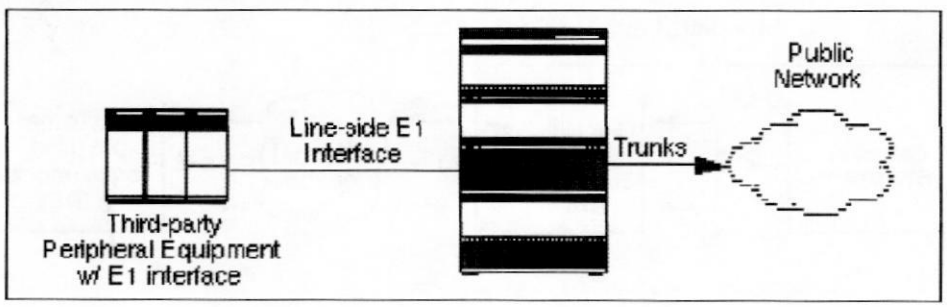
The LEI is an IPE line card that provides cost-effective connection between E1-compatible peripheral equipment and a Meridian 1 system or off-premise extensions over long distances.

Some examples of applications where an LEI can be interfaced to an E1 link are:

- E1-compatible VRU equipment
- E1-compatible turret systems
- E1-compatible wireless systems
- Remote analog (500/2500-type) telephones through E1 to channel bank
- Remote Norstar sites behind Meridian 1 over E1

The LEI is appropriate for any application where both E1 connectivity and "line-side" functionality are required. This includes connections to E1-compatible voice response units, voice messaging and trading turret (used in stock market applications) systems. See Figure 47.

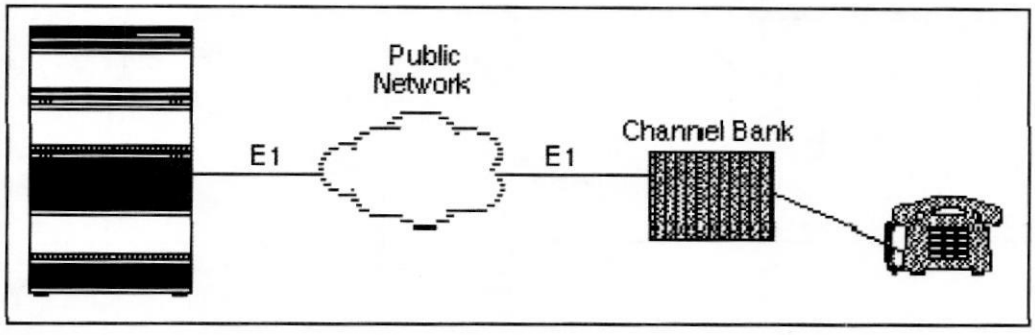
Figure 47
LEI connection to peripheral equipment



For example, the LEI can be used to connect the Meridian 1 to an E1-compatible Voice Response Unit (VRU). An example of this type of equipment is Nortel Networks Open IVR system. In this way, the Meridian 1 can send a call to the VRU, and, because the LEI supports analog (500/2500-type) telephone functionality, the VRU is able to send the call back to the Meridian 1 for further handling.

The LEI can also be used to provide off-premise extensions to remote locations, up to 500 miles from the Meridian 1 system. In this application, analog telephone functionality is extended over E1 facilities, providing a telephone at a remote site with access to analog (500/2500-type) telephone line functionality. See Figure 48. Audible Message Waiting Indicator can be provided as well.

Figure 48
LEI in off-premise extension application



Similarly, use the LEI to provide a connection between the Meridian 1 and a remote Norstar system. See Figure 49 on page 184. In this case, channel banks are not required if the Norstar system is equipped with an E1 interface.

Note: Consider LEI audio levels when determining the appropriateness of an application.

Figure 49
LEI connection to Norstar system